"These chemical changes and potential impacts on ocean biology are not something I feel comfortable contemplating," said Dr. Jorge L. Sarmiento, a professor of atmospheric and oceanic sciences at Princeton.

The recent shifts in the ocean's carbon dioxide content and chemistry have come after hundreds of thousands of years of relative stability, researchers say.

The top layers of the oceans, like the atmosphere, contained fairly unwavering concentrations of carbon dioxide for more than 400,000 years. During that span concentrations never rose above 280 parts per million.

But now concentrations are approaching 380 parts per million, and experts say it will be difficult to avoid a doubling of the pre-industrial levels by the end of the century.

Over many centuries, as slowly circulating ocean waters mix, the seas will easily be able to absorb 90 percent or more of the carbon dioxide liberated by human activities, but the impacts in the short term could still disrupt marine ecology, Dr. Feely said.

The possible marine effects of carbon dioxide emissions have become evident only in the last few years, experts said. More than 100 oceanographers and other scientists assessed the issue at a meeting in May in Paris and, in a statement last week, concluded that "effects are already occurring."

The participants said the increased absorption of acidic carbon dioxide by the seas "could have a significant negative effect on corals and other calcifying organisms, such as shellfish and some phytoplankton, disrupting marine food webs."

The changes being measured also appeared to be happening at rates far faster than natural fluctuations, they said.

"By the middle of this century, the accumulating burden of CO2 entering the ocean will lead to changes in pH or acidity of the upper layers that are three times greater in magnitude and 100 times faster than those experienced between ice ages," the participants said in the new concluding report.

The meeting was organized by a branch of the International Council for Science, a consortium of more than 100 scientific academies and unions, and the United Nations' International Oceanographic Commission.

Findings of the meeting are summarized on the Web at http://ioc.unesco.org /iocweb/co2panel/HighOceanCO2.htm.